UNITED STATES DEPARTMENT OF AGRICULTURE
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IMPRESSIONS OF APPLIED INSECT PATHOLOGY IN THE U.S.S.R.[1/]

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Agricultural Research Service

Impressions of insect pathology in the U.S.S.R. that I have gained from translating considerable amounts of Soviet literature as well as visiting briefly several Soviet laboratories in 1973 are that:

. Applied insect pathology in the U.S.S.R. has developed unique trends that may have major practical and scientific significance.

. The U.S.S.R. has far greater effort in insect pathology than any other country.

. Insect pathology will continue to receive very high priority in the future and certainly in the plans for the 5 years 1976 to 1980. Further, under the purview of the U.S./U.S.S.R. Agreement on Environmental Protection, we have initiated modest exchanges of microbial preparations and scientists, and there may be opportunities to expand these efforts and to initiate additional exchanges under the Science and Technology Agreement.

The scientists who participated in the Soviet-American Conference on Integrated Pest Control at Kiev in 1973 unanimously recommended an exchange program to the Joint Commission, including "joint trials of microbial preparations for pest control purposes." Subsequently, Dr. Ray Eikenberry, Oklahoma State University, received preparations of *Beauveria bassiana* from the All-Union Scientific Research Institute of Microbiological Methods for Plant Protection and Bacterial Preparations. Also, Dr. Howard Dulmage, Agricultural Research Service, Brownsville, Tex., supplied many *Bacillus thuringiensis* isolates to the U.S.S.R. Ministry of Agriculture. In August 1974, Dr. Carlo Ignoffo and Dr. R. L. Ridgway visited the U.S.S.R. to learn firsthand of efforts underway. Several scientists who play key roles in insect pathology

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1/ Based on a paper delivered at the annual meeting of the Society for Invertebrate Pathology, Arizona State University, Tempe, Ariz., June 17, 1974.

in the U.S.S.R. visited the United States in mid-July 1974 in connection with the U.S./U.S.S.R. symposium on the role of models in predicting pest populations. These scientists included Drs. E. M. Shumakov Deputy Director, All-Union Scientific Research Institute for Plant Protection, Leningrad; V. P. Vasiliev, Director, Ukrainian Scientific Research Institute for Plant Protection, Kiev; and S. Alimuchamedov, Director, Mid-Asiatic Scientific Research Institute for Plant Protection, Tashkent. Additional bilateral conferences on specialized aspects of integrated pest control are being planned for future years.

U.S.S.R. POLICIES CONCERNING INSECT PATHOLOGY

The Five Year Plan of 1966-70 for the first time gave very high priority to managing pest populations by "enriching the biocenoses with beneficial organisms" (Shchepetil'nikova and others 1971).[2/] Shchepetil'nikova Fedorinchik, and Gusev (1971) stated that an important thrust under this Five Year Plan was the "joint utilization of parasitic and predatory insects and micro-organisms in the same agrobiocenoses. This makes it possible to create complexes of methods of biological control as bases for integrated systems with a predominance of biological and other nonchemical agents."

These authors reported that this 5-year thrust yielded first, the development of a complex of methods of biological control of orchard pests in northerly regions with one generation of tortricids. This complex of methods involves the use of entobacterin, *Trichogramma,* the undersowing of orchards with nectiferous plants for supplementary feeding of entomophages and preservation of predators of fruit mites through restriction of insecticide use to one application early in spring.

However, this 5-year thrust did not fully succeed in developing a complex of biological measures for managing pests in orchards in the southern U.S.S.R. Nevertheless, it produced the wide acceptance of the joint use of micro-organisms and beneficial insects for protecting cabbage from *Barathra brassicae, Diataraxia oleracea, Pieris brassicae, Pieris rapae, Plutella maculipennis,* and *Mexographe forficalis.* In aggregate, nonchemical measures are currently based on 6 million hectares in the U.S.S.R. In 1973 *Bacillus thuringiensis* preparations were applied to 250,000 hectares.

Second, this thrust established that microbial infections decrease or eliminate the immunity of certain insect pests to parasitic insects and that parasitic insects promote epizootics by vectoring the diseases of insect pests. During this same period, the biopreparation arenarin was registered in the U.S.S.R. for control of bacterial canker and other bacterial diseases of tomatoes; also, the fungus, antagonist, *Trichoderma,* the antibiotic, trichotecin, along with releases of the predatory mite, *Phytoseiulus,* were brought into commercial use on cucumbers in greenhouses to control root rot,

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2/ Author or authors followed by year in parentheses refer to item in Literature Cited, p. 16.

powdery mildew, and spider mites. Further methods were developed for the possible utilization of nuclear polyhedrosis and granulosis viruses for control of the fall webworm *Hyphantria cunea*, and preparations of *Beauveria bassiana* plus carbaryl were developed for the control of the Colorado potato beetle. Finally, diagnostic methods were devised for the prediction of trends of pest populations with various levels of latent or active infections.

The current Five Year Plan (1971 to 1975) gives priority to the following lines of research and development:

1. Extension of biological control technology to all important commercial fruit-growing regions.

2. Development of integrated systems of protecting the principal vegetable crops and potatoes with predominant reliance on biological agents.

3. Development of biological methods for protecting vegetable crops in greenhouses from the principal insect pests and diseases.

4. Development of the fundamentals of predicting trends in pest populations and for predicting the effects of beneficial organisms.

5. Development of methods for conserving and enhancing the effectiveness of indigenous biological control agents in agroecosystems.

6. Development of the capability to mass produce and select promising species of beneficial insects and micro-organisms (Shchepetil'nikova and others 1971, Smetnik)[3/]. The confident dedication to this effort to develop selective methods of plant protection was reaffirmed in September 1972 by the resolution of the Supreme Soviet of the U.S.S.R. entitled, "On Measures for Further Improvement of Environmental Protection and Rational Use of Natural Resources (Borodkin 1973). The resolution states that "Achievements of the scientific and technical revolution and the powerful base of Soviet industry make it possible .... to intelligently utilize all natural resources and to successfully solve the historically important problem--neutralization of the side effects of farming activity, harmful to nature and man ....." Further, Dr. V. A. Shapa Director of the All-Union Scientific Research Institute for Biological Methods of Plant Protection, informed me that the long-term goal in the U.S.S.R. is to resolve 70 percent of pest problems by selective methods and 30 percent with broad spectrum pesticides.

LEVEL OF EFFORT AND ORGANIZATION OF INSECT PATHOLOGY IN THE U.S.S.R.

Based on my very limited contact with the Soviet scientific literature, I compiled a directory of roughly 230 scientists conducting research on

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3/ Personal communication from Smetnik, A. I., Soviet Trade Commission, Washington, D.C.

insect pathology in the U.S.S.R. (appendix 1). Based on the amount of literature which I gleaned, I estimate that the actual number may approximate 600, and Dr. A. I. Smetnik of the U.S.S.R. Embassy has assured me that this estimate is reasonably accurate. According to Dr. Smetnik, my list lacks most of the pertinent scientists in the Ministry of Forestry and in the Ministry of the Microbial Industry. My list is deficient also in the pathologists in medical entomology. In addition, a large number of scientists and technicians with some training in insect pathology are engaged in survey activities of the State Network for Diagnosis and Prediction. This network makes observations at 2,400 sites throughout the U.S.S.R. (see Polyakov 1973; Smetnik, footnote 3) as a basis for recommending control measures and for assessing their effectiveness.

In the U.S.S.R. scientific research is planned and coordinated in a broad sense by the Committee on Science and Technology of the U.S.S.R. Council of Ministers (fig. 1). Evidently insect pathology is represented on this Committee primarily through the All-Union Lenin Academy of Agricultural Sciences, the U.S.S.R. Academy of Sciences, the Ministries of Agriculture of the various Republics, Ministry of Forestry, and the Ministry of the Microbial Industry. Further interagency coordination is provided by the All-Union Coordinating Committee for Plant Protection of the U.S.S.R. Ministry of Agriculture (fig. 1). The All-Union Lenin Academy of Agricultural Sciences (VASKHNIL) has a very powerful influence on agricultural research throughout the U.S.S.R., and a list of its institutes is included as appendix 2. However, agricultural research is also conducted in the "Branches" of the Ministry of Agriculture. The relationship of VASKHNIL to other agencies in the U.S.S.R. Ministry of Agriculture is shown in figures 2 and 3. Further, the relationships of the All-Union Scientific Research Institute for Plant Protection are shown in figure 4. Branch and zone institutes with substantial research programs in plant protection are listed in appendix 3. The general organization of plant protection in the U.S.S.R. is shown in figure 5.

Doubtless most American insect pathologists are familiar with major well-established research efforts in the All-Union Scientific Research Institute of Plant Protection, Leningrad, the All-Union Scientific Research Institute of Microbiological Methods for Plant Protection and Bacterial Preparations, Moscow, the Ukrainian Scientific Research Institute of Plant Protection, Kiev, and the Institute of Microbiology and Virology, Kiev. Recently, at least two additional major efforts have been initiated at Novosibirsk and at Kishinev.

The effort on insect pathology at Novosibirsk was intensified in 1970 through the creation of the Siberian Scientific Research Institute of Chemization of Agriculture (SIBNIIKHIM). This work under the leadership of Dr. V. V. Gullii has two main thrusts: (1) Modification of chemical pesticide use patterns so that the actions of natural control agents are not impaired, and (2) development of methods of using indigenous beneficial insects and micro-organisms for protecting grain and vegetable crops. Major emphasis is placed on the use of viruses. By 1971 about 30 strains of viruses were isolated for use against a wide range of pests, including codling moth, gypsy moth, browntail moth, various moths attacking grain and cabbage, and Siberian silkworms. In addition to studies on epizootics, pathogenesis, and patho-morphology of virus infections in insects, work is carried out in the

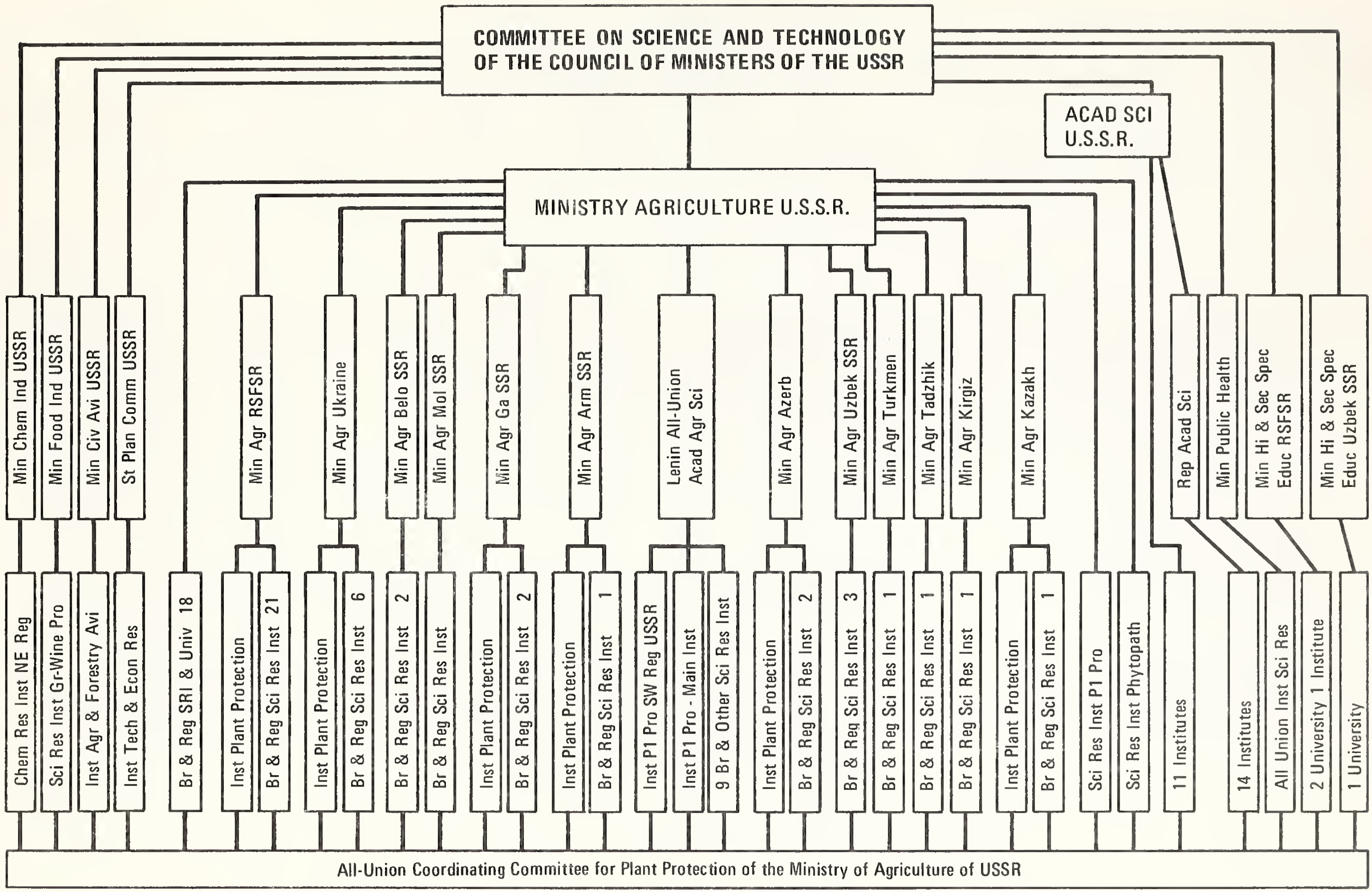

Figure 1.--All-Union Coordinating Committee for Plant Protection of the Ministry of Agriculture of U.S.S.R.

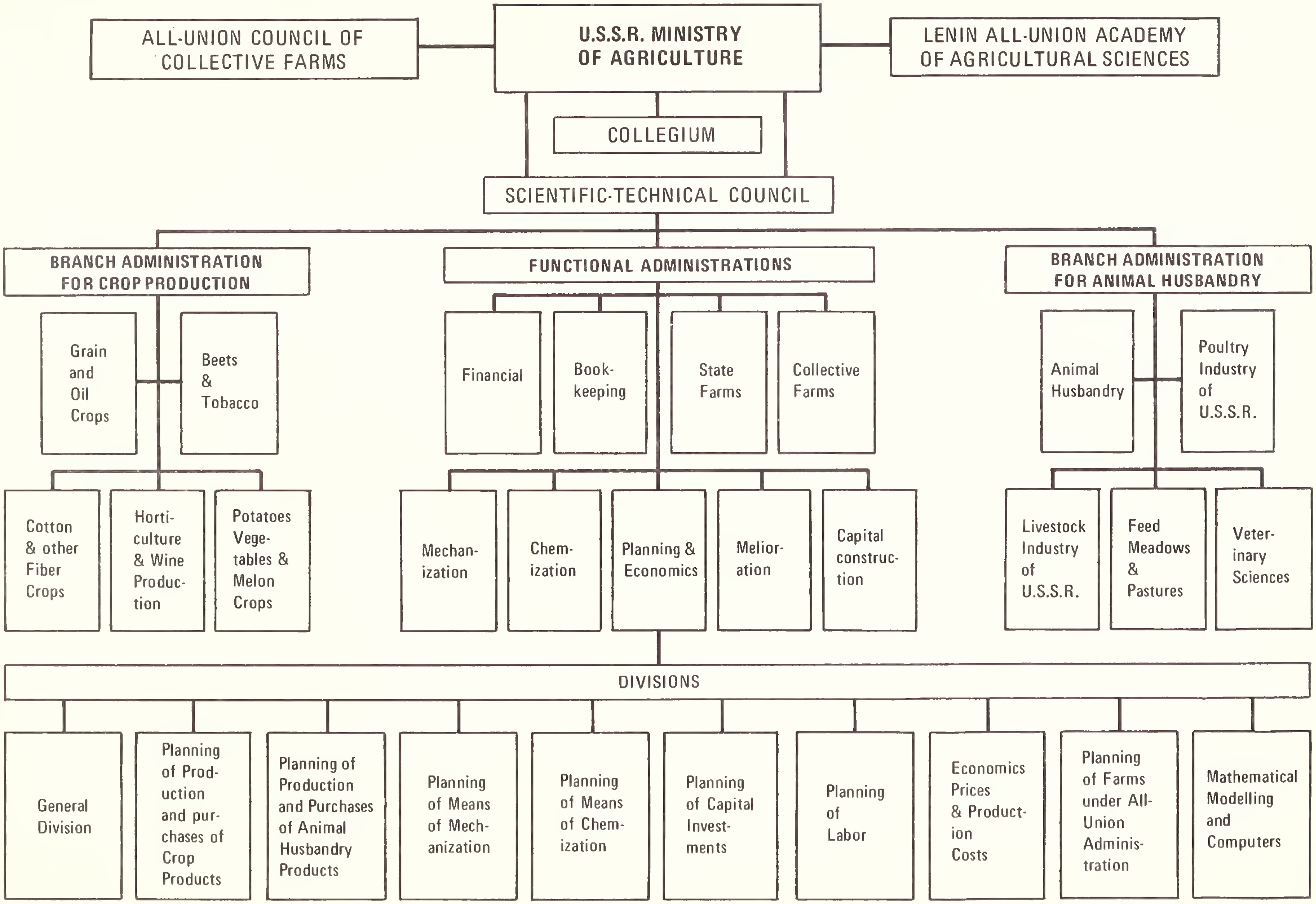

Figure 2.--Structure of U.S.S.R. Ministry of Agriculture, 1974.

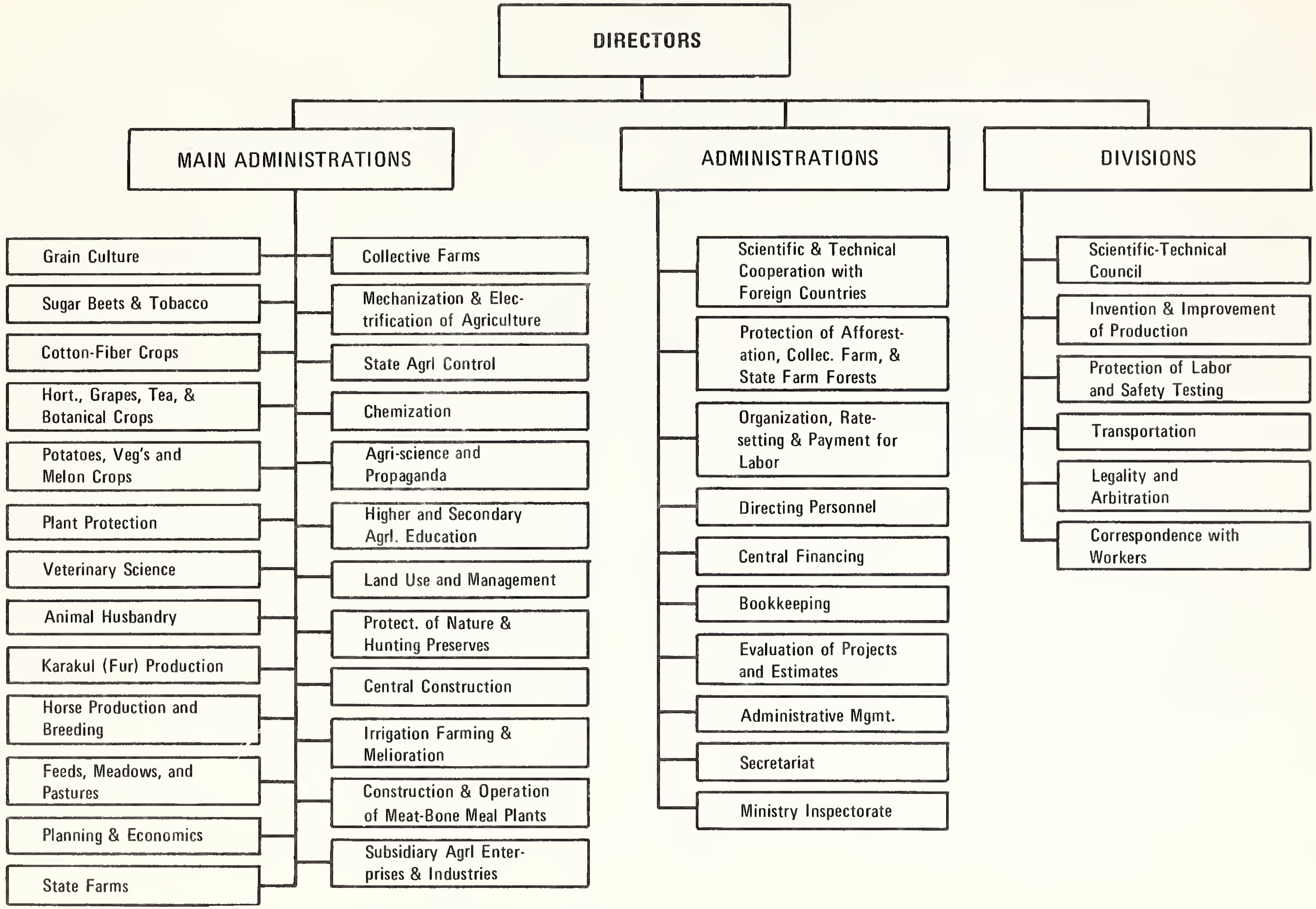

Figure 3.--Central apparatus of the U.S.S.R. Ministry of Agriculture, 1974.

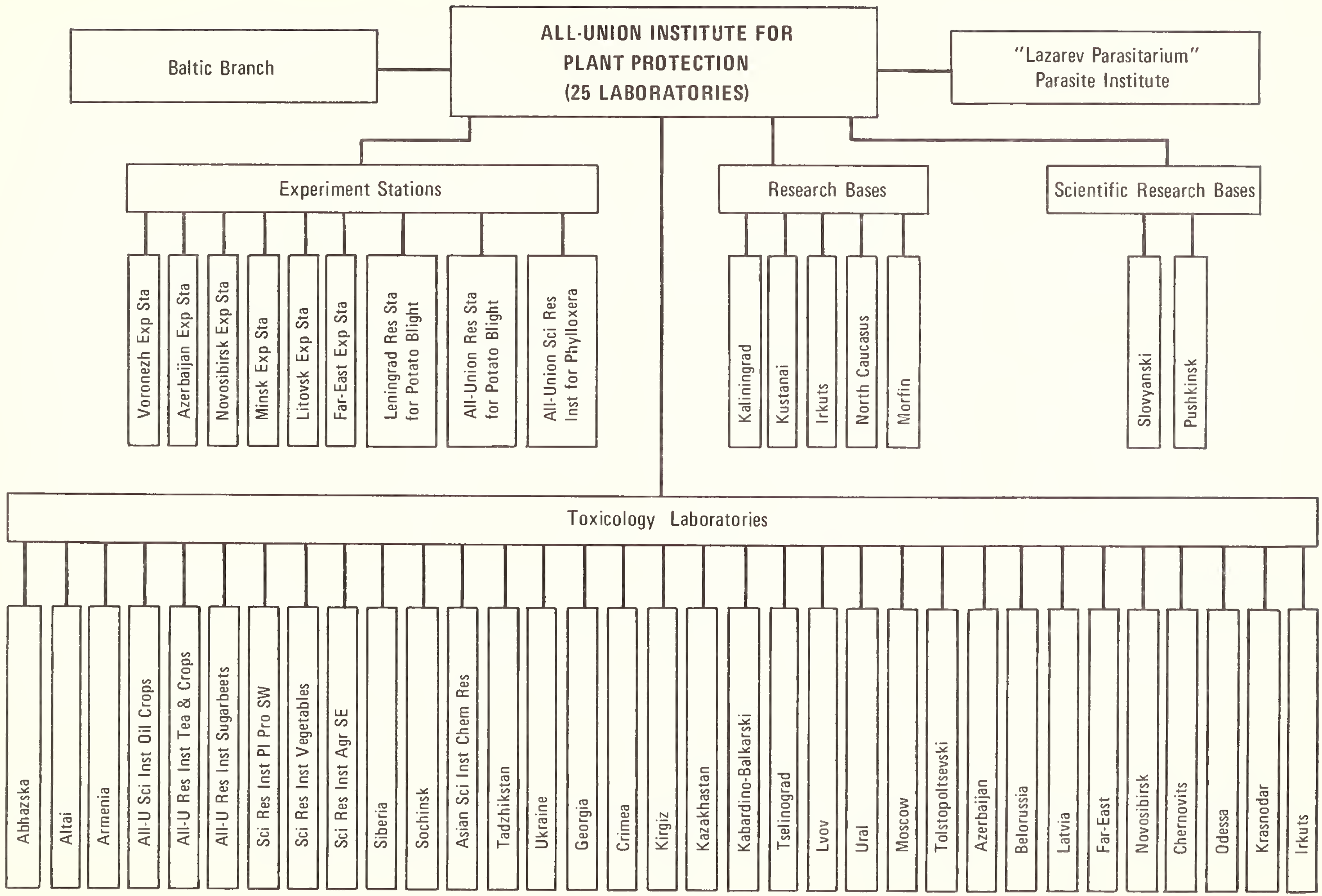

Figure 4.--Structure of the All-Union Scientific Research Institute of Plant Protection.

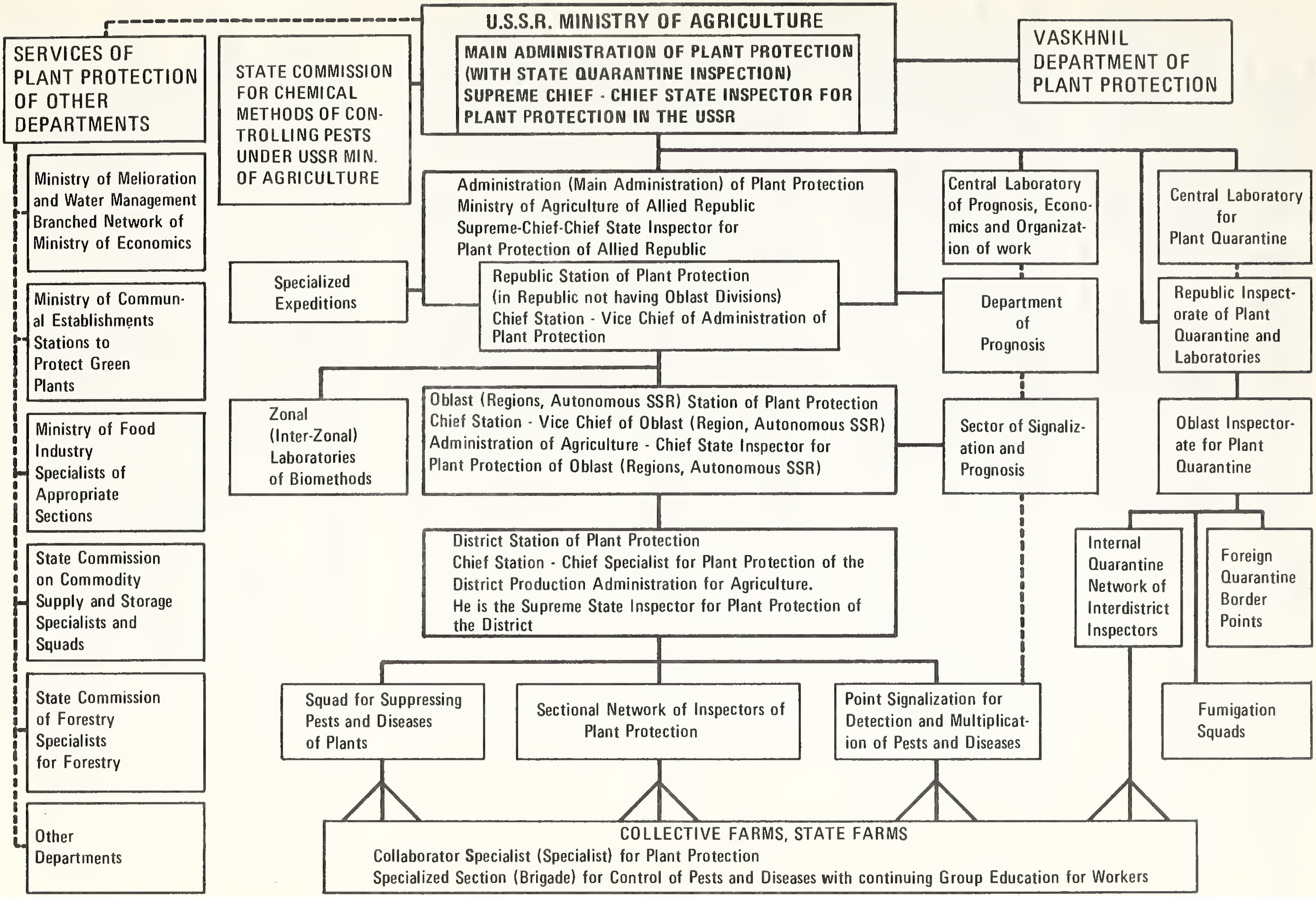

Figure 5.--Structure of Plant Protection Services in the U.S.S.R.

Institute on mass rearing of insects for virus production. Commercial scale tests with virus preparations have been carried out against the red pine sawfly, Turkestan browntailed moth, satin moth, and others (Gullii 1971).

The other major effort was initiated in 1970 in the All-Union Scientific Research Institute for Biological Methods of Plant Protection, Kishinev, under the leadership of Dr. A. I. Sikura. Dr. J. R. Brazzel and I briefly visited Dr. Sikura's Laboratory for Microbial Methods in 1973. The laboratory has a staff of 11 senior investigators and 17 technicians. The major thrusts of this laboratory include (1) discovery of micro-organisms that are highly virulent toward tortricids and other pests and which are safe for beneficial insects; (2) refining rates of application of biopreparations and insecticidal additives, also evaluating the effectiveness of biopreparations applied to tree trunks directly or impregnated in bands; (3) epidemiology with particular attention to the long-term aftereffects on pest and beneficial species of treatments in consecutive years, and the creation of persistent centers of infection; (4) physiopathology; and (5) development of mass production for microbial preparations. Currently the emphasis is on all kinds of diseases of the fall webworm, *Hyphantria cunea,* and on the leaf rollers, *Lobesia botrana* and *Clisia ambigoela.*

About 50 isolates of crystalliferous bacteria are being studied to determine key taxonomic characters and their pathenogenicity. Strains of *Beauveria bassiana* highly virulent to the codling moth, the plum moth *(Grapholitha funebrana)*, and to the pear moth *(Carpocapsa perivoria)* are being developed. Attempts to increase the virulence of *Beauveria* are being made with mutagens. Incidentally, a commercial plant for production of boverin is under construction in Kishinev (Smetnik, personal communication).

Nuclear polyhedrosis viruses have been isolated for *Barathra brassicae, Agrotis segetum,* and *Hyphantria cunea.* Formulations of the *Hyphantria* NPV remain active on mulberry for 14-15 days. Since the mass-rearing facility for *Hyphantria* had not been built, the virus was produced on artificial field infestations. This NPV is also effective against *Pieris rapae* but not *Bombyx.* Some of the *Pieris rapae* larvae infected with NPV also were parasitized by a tachinid. The tachinid larvae emerged but failed to pupate and died. Histological examination revealed that these larvae were infected with the NPV.

The Laboratory of Microbial Methods also studies protozoan diseases. *Nosema carpocapsa* is being studied in natural populations of the codling moth and is transmitted transovarially. In various climatic zones of the U.S.S.R., the percent infection of the codling moth reaches 70 percent, but mortality is not great. Efforts are underway to increase the virulence of the disease.

A 6,500-hectare State farm is associated with the Institute and permits field evaluation of microbial preparations in orchards and potato fields. The preparations are applied in 1,000 to 1,500 liters of water per hectare of orchard and in 100 to 400 liters per hectare of potatoes. This work seems to be constrained by the lack of sophisticated application equipment. The usual size of the experimental plot is from 7 to 8 hectares.

The laboratory is well equipped for biochemical studies and for electron microscopy. Biochemical changes in the integument and various organs and tissues of diseased insects are being characterized. Changes in hemolymph amino acid and peptides appear to be particularly useful for diagnosis and prognosis. Pathological changes in the gonads of the Colorado potato beetle infected with *Beauveria bassiana* were found to greatly reduce the fertility of the pest (Sikura and Sikura 1971). Further fungal infections drastically reduce lipid reserves of various pests so that winter mortality of diapausing insects is increased 2-3-fold.

The laboratory is studying ways of using microbial preparations to control the codling moth and leopard moth. Entobacterin and boverin alone are ineffective. However, when these preparations are mixed with one-tenth the commercial rate of a chemical insecticide, such as Fosalon, carbaryl, chlorophos, or dipterex, and applied against second generation codling moths, the mortality is about 90 percent. The immediate survivors undergo greatly increased winter mortality, and fertility of the spring flight is quite low. The reduced rates of insecticides kill about one-third to one-half as many beneficial insects as normal rates. At these reduced rates, predatory mites survive so that phytophagous mite problems are greatly reduced. Thus, through annually repeated application of biopreparations, the level of codling moth infestation is progressively reduced (Sikura and others 1971).

SOME DISTINCTIVE TRENDS IN APPLIED INSECT PATHOLOGY IN THE U.S.S.R.

In the U.S.S.R. there appears to be a pronounced orientation to maximizing the actions of natural enemies in suppressing pests. Such an orientation seems readily parlayed into an operating policy for the following reasons:

(1) The U.S.S.R. has a highly developed organization for assessing levels of pest and beneficial insect populations, assessing levels of latent and active infections, and for predicting their trends. At least one entomologist and one plant pathologist are stationed in nearly every district ("rayon") for this purpose. These scientists are supported by specialists in Regional ("oblast") Plant Protection Stations. In addition, nearly all State and Collective farms have an agronomist trained in pest management.

(2) Agriculture in the U.S.S.R. is fairly labor intensive with over 30 percent of the population residing on State and Collective farms. Thus, the manpower is available for population assessment, distribution of natural enemies, and related activities.

(3) Probably five times as many scientists are engaged in pest control research in the U.S.S.R. as in the U.S. so that expert advice can be provided fairly readily to collective farms.

(4) Since all farmland is collectivized, uniform practices can be implemented readily over large areas; and

(5) Registration and regulation of pest-control methodology in the U.S.S.R. appear to provide the flexibility needed for implementing sophisticated and complex pest management strategies (Smetnik, personal communication).

Fedorinchik (1973) has outlined some of the main thrusts in insect pathology in the U.S.S.R. Evidently the major research thrust consists of development of techniques to activate latent infections in pest populations to provide reliable suppression of pests. This artificial induction of epizootics has been shown to be strongly influenced by beneficial insects and by chemical insecticides. Unfortunately, I have not been able to find or obtain comprehensive descriptions of the techniques used to induce epizootics.

Depending upon the dose of chemical insecticide employed, it can either eliminate or activate and promote an epizootic. According to Fedorinchik (1973), conventional doses of insecticides strongly tend to preclude or eliminate epizootics (fig. 6) because diseased insects are considerably more susceptible to insecticides than healthy insects. Thus, conventional rates of insecticides differentially eliminate those insects which provide the reservoirs of pathogenic micro-organisms or viruses that are needed to initiate the epizootic. Conventional rates of insecticides also eliminate beneficial insects which may play a decisive role in vectoring micro-organisms. According to Fedorinchik (1973), an important vector role has been established for species which thrust the ovipositor into the host; such vector species include *Apanteles glomeratus, Agitis fenestralis, Anislastus ebeninus,* and *Pteromalus puparum.*

On the other hand, insecticides can be used to induce and promote epizootics provided that they are applied at roughly one-tenth conventional rates. Such doses stress the pest sufficiently to activate its latent infection and to permit the pest's intestinal microflora to behave pathogenically (fig. 5). According to Smetnik (personal communication), persistent insecticides such as polychlorpinene are more effective in inducing and promoting epizootics than fugitive insecticides such as trichlorfon. Further, such reduced rates of insecticides spare beneficial insects which either vector the disease or which directly suppress the pests. The use of low doses of insecticides with microbial preparations permits a 10-fold reduction of the dose of the microbial preparation. The low doses of insecticides also increase the reproducibility of the action of the microbial preparation. Thus, the mixtures are effective over a wider range of temperature and humidity than either insecticides or microbial preparations alone; so that the effectiveness of insecticide-bacterial mixtures is extended to low temperatures and the effectiveness of insecticide-fungal mixtures is extended to dry conditions (Telenga and Sikura, 1968).

The U.S.S.R. has a highly developed nationwide network which diagnoses the likelihood that an epizootic will occur or that it can be induced and which provides predictions on trends of pest populations (fig. 7). This State Network for Diagnosis and Prediction has trained employees in nearly every district ("rayon") and has supporting laboratories for diagnosis and prediction at each regional ("oblast") plant protection station. In addition, a very strong research effort appears underway in all major plant protection research institutes on developing and refining diagnostic methods, on economic thresholds, and on predicting pest populations.

A related research thrust deals with elucidating the positive effects of pathogens on beneficial insects. According to Fedorinchik (1973), studies

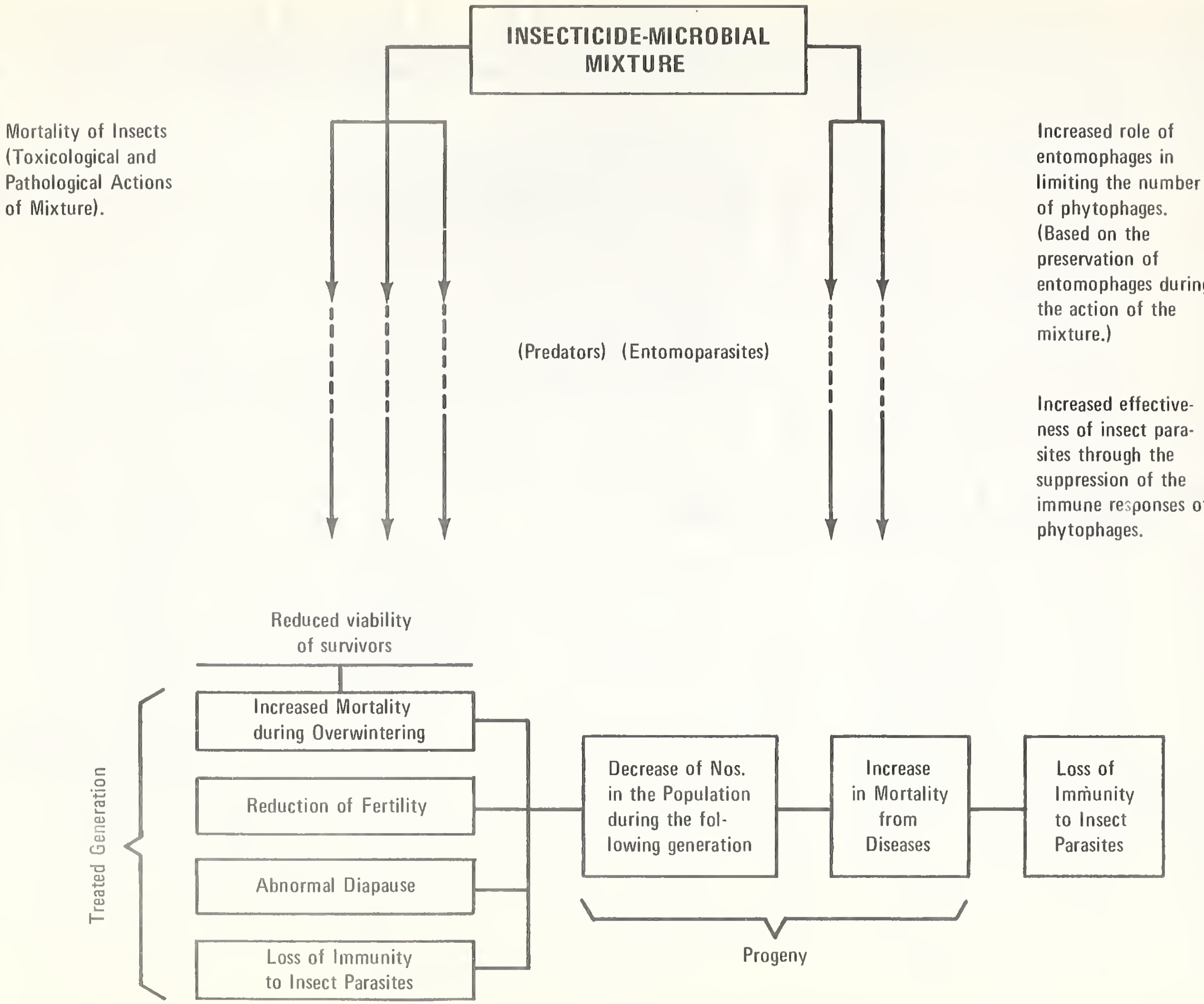

Figure 6.--Basic theoretical principles of the biomethod of insect pest control with the use of insecticide-microbial mixtures. (Redrawn from Telenga and Sikura, 1968.)

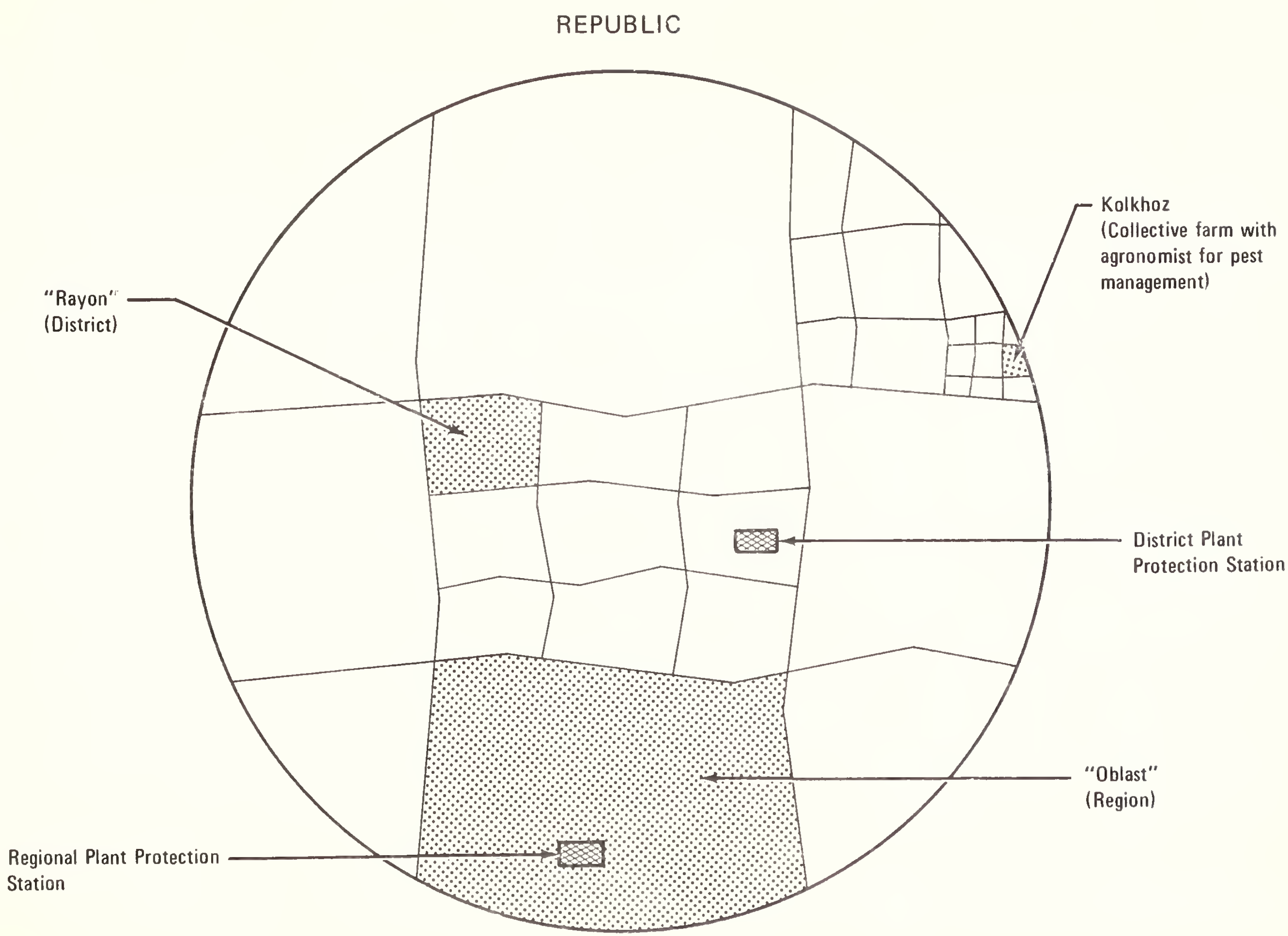

Figure 7.--Location of Plant Protection stations in a generalized Republic. These stations are components of the State Network of Diagnosis and Prediction.

conducted in the All-Union Scientific Research Institute for Plant Protection have established that *Bacillus thuringiensis* var. *galleriae* at less than one-tenth conventional rates reduces by about 50 percent the capability of *Pieris brassicae* and *Barathra brassicae* larvae to encapsulate the eggs of the larva parasites, *Anislastus ebeninum* Agrev. and *Sagaritis holmagneri* Nisch. At higher dose rates of *Bacillus thuringiensis* such immune responses are eliminated.

Doubtless, the major effort in applied pest management research in the Soviet Union consists of devising specific combinations of programed releases of beneficial insects along with mixtures of microbial preparations and minimal quantities of chemical insecticides to control the various complexes of pests found in various regions of the U.S.S.R. For example, the Ministry of Agriculture approved such joint use of measures for use on cabbage throughout the U.S.S.R. This complex of measures includes (1) use of entobacterin to control the cabbage and turnip white butterflies, the diamondback moth, *Plutella maculipennis,* and the pyralid, *Mesographe forticalis*; and (2) programed releases of *Trichogramma* against the noctuids, *Barathra brassicae, Polea oleracea,* and others.

DEVELOPMENT AND COMMERCIAL USE OF MICROBIAL INSECTICIDES

A major effort is underway in the U.S.S.R. to develop microbial and viral preparations for use against all kinds of pests. Two preparations of *Bacillus thuringiensis* (Entobacterin-3 and Dendrobacillin) are produced in multitonnage quantities (Fedorinchik 1973). In 1972, they were used on 250,000 hectares. Evidently, bacteriophages create difficulty in rapidly expanding production. Boverin derived from *Beauveria bassianna* is made in a two-step fermentation process. Nevertheless, one ton was produced in 1973 and 10 tons probably will be produced in 1974. A list of preparations in commercial use and under development is provided in appendix 4.

In conclusion, insect pathology apparently is a very powerful force in plant protection in the U.S.S.R. Indeed, the findings in insect pathology are stimulating drastic changes in the approaches to using chemical insecticides as well as the programed releases of beneficial insects. Developments in the Soviet capability to induce epizootics and to provide effective "centers of infection" as well as their techniques to diagnose latent infections and to predict population trends deserve careful attention. Commercial development of a variety of insect pathogens appears to be proceeding more rapidly in the U.S.S.R. than in the U.S. The approach to the regulation of the use of insect pathogens in commercial agriculture and forestry deserves special study. Research on formulation and methods of application is not advanced but is receiving increased support. The latter technology, however, can be obtained from abroad through commercial channels. Clearly, applied insect pathology in the U.S.S.R. has a number of exciting thrusts under development by many enthusiastic and competent scientists.

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1968. A Combination of Chemical and Biological Means for Plant Protection. All-Union Institute of Scientific-Technical Information for Agriculture, Moscow.

APPENDIX 1--PARTIAL LIST OF INSECT PATHOLOGISTS IN U.S.S.R.

Kazakhstan Institute of Plant Protection Alma Ata

Nulibaeva, R. N. - NPV & GV transovarial transmission

Institute of Biology
Academy of Sciences of Latvian SSR
Riga

Burtzeva, L. T. - mutants of *Bacillus thuringiensis*
Čhudare, Z. P. - *Entomophthora thaxteriana*
Egina, K. Ya. - control of aphids and spider mites under greenhouse conditions with *Entomophthora thaxteriana*
Khrameeva, A. V. - new strains of *B. t.*
Petrova, V. I. - spore formation of *Entomophthora*
Priyeditis, A. - ecological effects
Simonova, E. Zh. - control of apple-tree ermine moth with NPV
Tzibulska, A. I. - pathological changes induced by *Beauveria*
Tzinovskii, Ya. P. - control of aphids and spider mites under greenhouse conditions with *Entomophthora thaxteriana*
Vilyuma, A. P. - *Entomophthora*
Yakshevitz, M. R. - cytochemistry of *Entomophthora*

Latvian Agricultural Academy

Rituma, I. A. - control of *Malacosoma* with NPV
Zarin, I. A. - control of *Malacosoma* with NPV

Latvian Scientific Research Institute of Forestry Problems

Bichevskis, M. Ya. - diseases of spider mites

Institute of Microbiology of Augusta Kirkhensteina
Academy of Sciences Latvian SSR

Kristansons, M. Zh. - microbial synthesis
Viester, V. E.

Latvian Order of Trudovo Krasnovo Zameni Agricultural Academy

Zarin, I. Z. - European pine sawfly control with NPV

Institute of Phytopathology
Far East, Kamen - Ribolow, USSR

Klochko, M. D. - Entomogenous fungi for insect control

Far East Scientific Research Institute for Forestry
Yakutsk, USSR

Nakonechnii, V. I. - mixtures of microbial and chemical insecticides

Gruzinskii Institute of Sericulture
Gruzia, USSR

Lobhanidze, V. L. - silkworm diseases
Odikadze, V. V. - silkworm diseases
Ovanesyan, T. T. - silkworm diseases

Agricultural Institute
Cherson, U S.S.R.

Macuschenko, Ivga W. - microsporidia of Lepidoptera
Romanenko, W. A. - bacteria, viruses
Tshugunin, J V. - viruses, bacteria, microbial control

Irskutsk State University
Biology - Soils Faculty
Department of Physiology & Microbiology
Vusovskaiia Nab. 20 Irkutsk, USSR

Androsova, L. N - *B. t.*
Lebedeva, N. P. - *Bac. insectus*
Kulagir, V. S. - *Bac. insectus*
Talalayev, E. V. - Bacterial infections of insects
Talalayeva, A. B. - *B. t.*
Tulpanov, Y. A. - *Beauveria bassiana*

Univesitet Im Zhdanova, A. A.
Irkutsk, USSR

Tiumenzev, S. N. - mode of action of *B. t.*

Institute of Microbiology
Academy of Sciences of Armenian SSR
Erevan, Charentz 19, USSR

Afrikan, E. G. - bacteria, silkworm diseases

Armenian Scientific Research
Institute of Plant Protection
Ministry of Agriculture of Armenian SSR
Erevan, USSR

Chilingaryan, V. A. - microbial and chemical mixtures
Kazarian, B. K. - bacterial preparations for insect control
Ormanian, Zh. Kh. - bacterial preparations for insect control
Safarian, S. E. - bacterial preparations for insect control
Tschilingarian, V. A. - bacterial preparations for insect control

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Georgian Scientific Research Institute of Plant Protection

Rachvelishvili, E. V. - field studies on *Entomophthora aphidis* *Fusarium* sp., *Trichotecium* sp. and *Beauveria bassiana*

Kuban State University
Krasnodar

Kosmachevskii, A. S. - control of fall webworm with NPV & GV
Osennaya, T. A. - control of fall webworm with NPV & GV
Yaroshenko, V. A. - control of fall webworm with NPV & GV

Azerbaidzhan Scientific Research Institute of Plant Protection
Kirovabad

Imanov, N. M. - control of *Acacia* soft scale with *Cordyceps* clavulata fungus

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Institute of Zoology
Academy of Sciences of Azerbaidzhan SSR

Aliev, A. A. - use insecticide - boverin mixtures
Beibutor, R. A. - *Beauveria* for codling moth control
Lagazidze, G. - insecticide - entobacterin mixtures
Pishnamazev, G. - insecticide - entobacterin mixtures

Institute of Infectious Diseases
USSR Ministry of Public Health
Kiev

Landau, S. M. - cell culture of NPV
Radolitzkaya, L. S. - cell culture of NPV
Zvinchuk, G. A. - cell culture of NPV

Ukrainian Scientific Research Institute of Plant Protection
Vasilkovskaya 51, Kiev 22, USSR
(Dr. V. P. Vasilyev, Director)

Degtyareva, E. N. - influence of boverin on metabolism
Goral, V. M. - Industrial Insect Pathology
Gritsaenko, N. N. - effect of *Beauveria* on fat metabolism of codling moth
Krasnitskaya, R. A. - influence of temperature on GV infection
Kravchenko, O. N. - culture of *Beauveria*
Lappa, N. V. - fungi, bacteria, protozoa, and hematology
Lomakin, M. P. - insect viruses
Nagornaya, I. M. - hematology
Primak, T. A. - *Beauveria*
Pristavko, V. P. - combinations of insecticides and microbials
Rezvatova, O. I. - codling moth diseases
Rogochaya, L. G. - codling control with insecticide - microbial mixtures painted onto tree trunks
Sirotina, M. I. - hematology of Colorado potato beetle
Tron, N. M.'- insecticide - microbial mixtures also work on *Trichogramma*
Turchaninova, Z. A. - control of turnip moth with dendrobacillin
Visir, A. P. - culture of *Beauveria*
Yanishevskaya, L. T. - codling moth diseases
Zhigaev, G. N.

Institute of Microbiology and Virology
Division of Molecular Biology and Genetics
Academy of Sciences of the Ukrainian SSR
Zabolotny Street 37, Kiev 143, USSR

Bilai, V. I. - synergism of NPV and endobacterin with mycotoxins against gypsy moth
Drakhlis, E. P. - effect of mycotoxins and entobacterin on enzymes of Lepidoptera

Gashko, A. P. - induction of NPV in silkworms
Gershenson, S. M. - viruses of insects
Gudz-Gorban, A. P. - infectivity and structure of NPV DNA in silkworm
Kok, I. P. - viruses of Lepidoptera
Kostyukovskii, M. G. - effect of mycotoxins and entobacterin on enzymes of Lepidoptera
Kubaichuk, V. P. - synergism of NPV and entobacterin with mycotoxins against gypsy moth
Manyakov, V. Yu. - NPV of Galleria
Miloserdova, V. D. - host specificity of viruses
Mikonenko, V. U - NPV of Galleria
Primachenko, L. V. - host specificity of viruses
Sherebtzova, E. N. - NPV of Galleria
Shkaruba, N. G. - synergism of NPV and entobacterin with mycotoxins against gyspy moth
Sinitskii, N. N. - synergism of NPV and entobacterin with mycotoxins against gypsy moth
Sinitskii, V. N. - synergism of NPV and entobacterin with mycotoxins against gyspy moth
Skuratovskaya, I. N. - viruses of Lepidoptera
Solomko, A. P. - infectivity and structure of NPV DNA in silkworm

Institute of Zoology*
Ukrainian Academy of Sciences
Vladimirskaya 55, Kiev, USSR

Brezgunova, T. G. -silkworm diseases, viruses
Karpov, A. Ye. - latency of silkworm diseases, viruses
Kidra, M. S. - silkworm diseases, viruses
Medvedva, Nat. B. - viruses, tissue culture

*This Institute may have been absorbed by the Institute of Microbiology and Virology.

Ukrainian Agricultural Academy
Kiev

Diadetchko, N.
Krisventsov, Yu. I. - mixtures of entobactrin, boverin plus trichlorfon
Opanasyuk, T. I. - mixtures of entobactrin, boverin plus trichlorfon

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Crimean Horticultural Experiment Station

Slavgorodskaya, L. E. - microbial and chemical mixtures for codling moth control

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Lazarev Parasitarium of the All-Union Institute of Plant Protection
Lazarevskaya (near Krasnodar)

Kiselek, E. V. - survival of *B. t.* in soils
Sogoyan, R. S. - effect of gut pH on intestinal microflora and effectiveness of *B. t.*

All-Union Scientific Research Institute of Biological Methods of Plant Protection
7, Poltavskoye Shosse 31
Kishinev, USSR
(Dr. V. A. Shapa, Director)

Bevzenko, T. M. - *Beauveria* strains
Sikura, A. I. - fungi, applied insect pathology hematology
Sikura, L. V. - effect of *Beauveria* on insect fertility
Simchuk, P. A. - mixtures of microbial and chemical insecticides
Trebesova, R. M. - effect of *Beauveria* on fertility

Moldavian Research Institute of Horticulture, Viticulture and Wine-Making
Kishinev

Petruskhina, M. T. - entobacterin

Krasnoyarsk State University
Krasnoyarsk

Tyulpanova, V. A. - strains of *Beauveria*
Tyulpanov, V. G. - strains of *Beauveria*

Krasvoyarsk Forestry Institute
Research on Insectine

All-Union Scientific Research Institute of Plant Protection
Hertzen Street 42
Leningrad, USSR

Dormidontova, G. N. - virus, microbial control
Evlakhova, A. A. - fungi, microbial control
Fedorinchik, N. S. - microbial control
Isakova, N. P. - mode of action of *B. t.*
Issi, I. V. - protozoan-host relationships

Kirsanova, E. S. - selection of entomogenous fungi
Korostel, S. I. - *B. t.*, microbial control
Leskova, A. Ya. - bacteria, industrial propagation
Levitin, M. M. - mutant strains of *Beauveria*
Merkoolova, M. S. - mutant strains of *Beauveria*
Moiseeva, T. S. - transmission of bacteria Hymenoptera
Moultatuly, N. N. - *Bacillus thuringiensis*, phages
Nasedkina, G. A. - *Bacillus thuringiensis*, selection
Orlovskaja, E. V. - viruses, applied insect pathology
Razumova, A. P. - bacterial diseases, physiopathology
Shchepetilnikova, V. A. - bacteria, policy, five-year plans (main interest is *Trichogramma*).
Shekhurina, T. A. - viruses, applied insect pathology
Shetzikova, O. T. - bacteria and viruses of cutworms, *Haden sordida* and *Agrotis segetun*
Simonova, A. S. - viruses, applied insect pathology
Stroeva, I. A. - *Bacillus thuringiensis*, thermostable toxin
Tarasoff, L. G. - fungi, biocontrol of insects
Velizkaya, I. S. - fungi
Veremtschuk, G. V. - Entomophilic nematodes, Steinermatidae
Voronina, E. G. - fungi, Entomophthoracea
Yurchenko, L. V. - *Beauveria*
Zakharov, I. A. - *Beauveria*
Zurabova, E. R. - bacteria, serology

Department of Embryology
Leningrad University
Leningrad USSR

Priezsheva, L. S. - bee diseases

All-Union Research Institute for Phytopathology
Leningrad

Kondratov, E. S. - mass rearing of cabbage moth for production of viruses and nematodes

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Zoological Institute
Academy of Sciences of USSR
Leningrad 164, USSR

Kirjanova, E. S. - Entomophilic nematodes, Mermithidae
Rubtsov, I. A. - Entomophilic nematodes, Mermithidae

All-Union Scientific Research Institute of Agricultural Microbiology
Hertzena Street 42
Leningrad, USSR
(Dr. G. S. Muromtsev, Director)

Berim, N. G. - control of cabbage flies with *B. t.* insecticide mixtures
Grebelskii, S. G. - use of bitoxibacillin (very broadspectrum *B. t.* strain 202).
Kandybin, N. V. - use of bactorodencide (*Salmonella enteritidis*) to selectively control rodents in orchards; also use of bitoxibacillin to control cutworms and Colorado beetle.
Koreshkova, T. N. - use of bactorodencide to control voles
Leshkova, A. Ya. - pathogenicity of Bacilli isolated from *Dendrolinus pini*.
Rassvetaeva, N. I. - mixtures of microbials and insecticides and hematology
Rybina, L. M. - mixtures of microbials and insecticides and hematology
Sharafutdinov, Sh. A. - use of bitoxibacillin
Simonova, L. A. - bitoxibacillin
Sinitsova, L. Ya. - use of bactorodencide to control voles
Stus, A. A. - use of bitoxibacillin

Zoological Institute
Academy of Sciences of the USSR
University Embank 1,
Leningrad B-164

Rubtsov, J. - mermithids

State Border Inspection for Plant Quarantine
USSR Ministry of Agriculture
L'vov, USSR

Myshachkov, G. A. - nematode parasites of Colorado beetle

Laboratory of Biomethods
Belorussian Scientific Research Institute for Plant Protection
Minsk, USSR

Korol, I. T. - fungi and bacteria, applied insect pathology
Lavnikevich, N. P. - effect of temperature on effectiveness of microbial and chemical insecticides
Moisenko, A. I. - *Beauveria*, entobacterin and insecticide mixtures for codling moth control.

All-Union Scientific Research Institute of Microbiological Methods
for Plant Protection and Bacterial Preparations
Moscow

Aleshina, O. A. - methods of deep fermentation of *Beauveria*
Belova, N. A. - influence of temperature and humidity on activity of boverin and entobacterin, also comparative activity of microbials against a wide variety of pests
Biryukova, A. P. - influence of temperature and humidity on activity of boverin and entobacterin, also comparative activity of microbials against a wide variety of pests
Bulztova, A. A. - culturing of *Beauveria*
Freeman, V. B. - *Bac. insectus* ultrastructure
Glinka, S. K. - *Bac. insectus* ultrastructure
Glushkova, A. I. - *Bac. insectus* ultrastructure
Il'icheva, S. N. - culturing of *Beauveria*
Kazakova, T. A. - culturing of *Beauveria*
Kolomieta, L. T. - influence of temperature and humidity on activity of boverin and entobacterin, also comparative activity of microbials against a wide variety of pests
Kozlov, A. I. - *B. t.*
Kushnarev, V. M. - *Bac. insectus* ultrastructure
Kuznetzov, Yu. S. - *B. t.*
Lubova, V. P. - culturing of *Beauveria*
Martinova, G. S. - cell culture of NPV
Mertzalov, V. M. - *Bac. insectus* ultrasturcture
Ostrogskaya, N. A. - influence of temperature and humidity on activity of boverin and entobacterin, also comparative activity of microbials against a wide variety of pests
Sarkisova, N. B. - culturing of *Beauveria*
Savina, V. E. - culturing of *Beauveria*
Shagov, E. M. - influence of temperature and humidity on activity of boverin and entobacterin, also comparative activity of microbials against a wide variety of pests
Shamrai, L. G. - Influence of temperature and humidity on activity of boverin and entobacterin, also comparative activity of microbials
Simonova, Z. Zh. - methods of preparing NPV
Sinitsyna, L. P. - influence of temperature and humidity on activity of boverin and entobacterin, also comparative activity of microbials against a wide variety of pests
Smirnova, T. A. - *Bac. insectus* ultrastructure
Soldatova, N. V. - cell culture of NPV
Tikhomirova, S. B. - *Bac. insectus* ultrastructure
Vrublevskaya, L. S. - influence of temperature and humidity on activity of boverin and entobacterin, also comparative activity of microbials against a wide variety of pests
Yerizaryan, L. A. - cell culture of NPV
Zinov'eva, L. A. - production of gypsy moth NPV, Virin-Ensh

Institute of Microbiology
Academy of Sciences of USSR
Prospect Vernadskogo 33, Moscow

Academik, Imsheneskiy, Director

Institute of Microbiology Academy of Sciences
Profsoyusnaya 7A, Prospect Lenina 33
Moscow, USSR B-133

Rautenstein, Ya. I. - general microbiology, phages
Tarasevitch, L. M. - viruses
Ulanova, E. F. - viruses, silkworm diseases

Institute of Virology
USSR Academy of Medical Sciences
Moscow, USSR D-98

Zhdanov, V. M., Director - virus classification

Laboratory of Helminthology
Academy of Sciences USSR
33 Lenina Prospect
Moscow, USSR

Lazarevskaya, S. S. - Entomophilic nematodes, Rhabditida

Laboratory of Experimental Embryology
Severtsov's Institute of Animal Morphology
Leninskii Prospect 33
Moscow, USSR

Bednjakova, T. A. - silkworm diseases

Institute of Developmental Biology
Academy of Sciences of USSR
Vavilov 26, Moskva B-33 USSR

Astaurov, B. L. - Microporidia, Theruic Disinfection

Research Institute of Bacterial Products
Konjushkovskaya 31, Moskva

Aloshima, Olga - *Bacillus thuringiensis*

Institute of Evolutionary Animal Morphology and Ecology
USSR Academy of Sciences
33 Leninskii Prospect, Moscow

Mamaev, B. M. - microbial insecticides

Central Quarantine Laboratory
Orlikov Perenlok 1/11, Moscow

Ponomavenko, Nadezhda - NPV and GV of *Hyphantria cunea*

All-Union Scientific Research Institute of Bacterial Preparations,
Moscow

Zinov'eva, L. A. - mass rearing of gypsy moth and mass production of NPV

Moscow Academy of Veterinary Medicine
Moscow 672, MVA, USSR

Poltew, W. I. - bee diseases

Patrice Lamumba University of Friendship
Ordjonikidze Street 3,
Moscow 203, USSR

Ezhov, G. I. - *Bacillus thuringiensis* and *Fusarium*

Biological Institute
Siberian Branch
Lenin All-Union Academy of Agricultural
Sciences of the USSR
Novosibirsk 91, Frunze 21, USSR

Chadzhieva, T. M. - insect viruses
Lukyanchikov, V. P. - insect viruses

Central Siberian Botanical Garden
Siberian Branch, Academy of Sciences of USSR
Novosibirsk, USSR

Gukassyan, A. B. - bacterial diseases

Siberian Research Institute of Chemization of Agriculture
1, Krivoshchekovskaya, 7, Novosibirsk
(Dr. O. A. Ivanov, Director) (Pathology Laboratory constructed in 1970.)

Gullii, V. V. - 30 strains of viruses, joint use of insecticides, insect mass rearing

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Scientific Research Institute of Apiculture
Rybnoje, Iruzanoskoi Oblast, USSR

Smirnova, N. I. - bee diseases

Morodovskii State University
Saransk, USSR

Yalovtsyn, M. V. - sport-forming bacteria

Botanical Institute
Uzebek Academy of Sciences
Tashkent, USSR

Dikasova, E. T. - general insect pathology, viruses
Ganieva, M. P. - viruses, silkworm diseases

Mid-Asiatic Scientific Research Institute for Sericulture
Tashkent, USSR

Chachanov, A. N. - silkworm diseases

Mid-Asiatic Scientific Research Institute for Plant Protection
Tashkent, USSR

Alimuchamedov, S. - silkworm diseases
Khamdan, Zadye, T. - dendrobacillin
Rasulov, F. - control cotton insects with dendrobacillin
Sharafudinov, Sh. - control cotton insects with dendrobacillin
Turapov, Yu. - control cotton insects with dendrobacillin

Uzbekistan Scientific Research Institute of Vegetables, Melon Crops and Potatoes
Tashkent

Muminov, A. M. - control of cutworms and cabbage butterfly larvae with dendrobacillin and entobacterin
Pestsov, Ya. I. - control of cutworms and cabbage butterfly larvae with dendrobacillin and entobacterin

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Institute of Zoology
Georgian Academy of Sciences
Tbilisi, Georgia USSR

Kakuliya, G. A. - Entomophilic nematodes, Tylenchoidea, Rhabditida

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Georgian Agricultural Institute
Tbilisi, USSR

Baburashvili, E. I. - Thermal cure of *Nosema* in silkworms

Institute of Zoology and Parasitology
Academy of Sciences of Lithuanian SSR, Vilnius

Ignatavichyus, I. - *B. t.*
Kabashinskaite, M. - *Beauveria, Spicaria, Penicillium, Fusarium*
Pusvaskitye, O. - microbial control of tortricids
Shalabiene, N. - *B. t.*
Shemetulskis, D. - *B. t.*
Stanenite, A. - *Beauveria, Spicaria, Penicillium, Fusarium*

Institute of Ecology and Parasitology
Academy of Sciences of Lithuanian SSR
Vilnius

Zhukauskena, Ya. I. - long-term after-effects of microbial preparations

Voronezh Station for Plant Protection
Serafimovitcha 26, Voronezh, USSR

Lepkova, N. V. - fungi, applied pathology
Prokhorova, K. P. - bacteria, applied pathology

Voronezh Forest Technology Institute
Voronezh, USSR

Artyukhovsky, A. K. - Entomophilic nematodes, Mermithidae, Steinermatidae
Khartsenko, H. A. - Entomophilic nematodes, Mermithidae, Sterinermatidae
Poloshentzev, P. A. - diseases of forest bed bugs
Poloshentzeva, N. I. - diseases of forest bed bugs

Voronezh State University
Voronezh, USSR

Negrobov, V. P. - Helminthology

Karpatskii Filial of Ukrainian Scientific Research Institute for Forestry

Okhotnikov, V. I. - delayed action of *B. t.* exotoxin

Kuibishevskii Institute

Basova, L. P. - *Entomophthora apiculata*

Biological Institute
USSR Academy of Sciences

Kalbishch, T. K. - antagonistic properties of fungi
Vorobeva, N. N. - NPV and GV transovarial transmission

Grodnensk Agricultural Institute

Nelen, E. S. - *Beauveria, Spicaria, Entomophthora, Fusarium* on orchard insects

Burkovskaya, T. I. - *Beauveria, Spicaria, Entomophthora, Fusarium* or orchard insects

Titova, E. M. - *Beauveria, Spicaria, Entomophthora, Fusarium* on orchard insects

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Pribaltic Branch of the All-Union Scientific Research Institute of Plant Protection
Kaliningrad

Svikle, M. - toxicity of boverin and insecticides to *Chrysopa* and *Coccinella*

Kirghiz Scientific Research Institute of Agriculture

Kartasheva, T. T. - joint use of entobacterin and dimethoate on codling moth

Lesteva, E. E. - joint use of entobacterin and dimethoate on codling moth

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Georgian Scientific Research Institute of Horticulture, Viticulture and Viniculture

Dolidze, G. V. - use of *B. t.* cyptolaemus predator to control leaf rollers and grape mealybugs

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Zacarpathian Plant Quarantine Laboratory

Dulo, Yu. V. - commercial scale tests of NPV - GV mixture to control fall webworm

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Soviet Trade Commission
Embassy of the Union of Soviet Socialist Republics
1521-16th Street, N.W.
Washington, D.C. 20036

Smetnik, A. I. - applied insect pathology

Quarantine Laboratory
Pjatigovsk, RSFSR

This laboratory has developed *Conotirium* fungus for suppression of San Jose scale, but lacks production capability.

Ministry of Forestry

Plokhukh, V. - control of forest pests with microbial agents

APPENDIX 2.--SOME IMPORTANT AGRICULTURAL RESEARCH INSTITUTES IN THE U.S.S.R.

Scientific Research Institutions of the All-Union Lenin Academy of Agricultural Sciences (Vaskhnil)

A. Department of Plant Industry and Plant Breeding
Academician-Secretary: N.V. Turbin

1. N.I. Vavilov All-Union Research Institute of Plant Industry, Leningrad. Director: D.D. Breshnev

2. All-Union Research Institute of Plant Breeding and Genetics, Odessa. Director: A.A. Sozinov

3. Mironovsky Research Institute of Wheat Breeding and Seed Production. P/O Mironovka, Kievskaya oblast

4. All-Union Research Institute of Maize Growing. Dnepropetrovsk. Director: A. I. Zadontsev

5. All-Union Research Institute of Pulse Crops. P/O Opytnaya stanitsiya. Director: F. K. Chapurin

6. All-Union Research Institute of Oil Bearing Crops. Krasnodar. Director: N.I. Dvoryadkin

7. All-Union Research Institute of Rice Growing. Krasnodar. Director: G.A. Romanenko

8. All-Union Institute of Vegetable Crops Breeding and Seed Production. P/O Lesnoy Gorodok, Moskovskaya oblast. Director: P.F. Sokol

9. I.V. Michurin Central Laboratory of Genetics. Michurinsk, Tambovskaya oblast. Director: Ya.S. Nesterov.

10. Nikitsky State Botanical Garden. Yalta, Crimea. Director: M.A. Kochkin

B. Department of Arable Farming and Chemization of Agriculture
Academician-Secretary: I.S. Shatilov

1. D.N. Pryanishnikov All-Union Research Institute of Fertilizers and Agronomical Soil Science. Moscow. Director: D.A. Korenkov

2. V.V. Dokuchaev Institute of Soil Science. Moscow. Director: V.V. Yegorov

3. All-Union Research Institute of Grain Farming. P/O Shortandy, Tselinogradskaya oblast. Director: A.I. Baraev

4. Agrophysical Research Institute. Leningrad. Director: S.V. Nerpin

5. All-Union Research Institute of Agricultural Microbiology. Leningrad. Director: S.S. Muromtsev

C. Department of Plant Protection
Academician-Secretary: Yu.N. Fadayev.

1. All-Union Research Institute of Plant Protection. Leningrad. Director: K.V. Novozhilov

2. All-Union Research Institute of Biological Methods of Plant Protection. Kishinev. Director: V.A. Shapa.

D. All-Union Department of Animal Husbandry
Academician-Secretary: N.F. Rostovtsev

1. All-Union Research Institute of Animal Husbandry Posyolok Dubroviksky Podolskyrayon. Moscovskaya oblast. Director: L.K. Ernst

2. All-Union Research Institute of Animal Physiology and Biochemistry. Borovsk, Kaluzhskaya oblast. Director: N.A. Shmanenkov

3. All-Union Research Institute of Animal Breeding and Genetics. Puskin. Director: M.M. Lebedev

E. Department of Veterinary Science
Academician-Secretary: A.A. Polyakov

1. All-Union Institute of Experimental Veterinary Science. Moscow. Director: Ya.R. Kovalenko

2. K.I. Skryabin All-Union Institute of Helminthology. Moscow. Director: V.S. Vershov

F. Department of Mechanization and Electrification of Agriculture
Academician-Secretary: P.N. Listov

1. All-Union Research Institute for Mechanization of Agriculture. Moscow. Director: G.M. Buzenkov

2. All-Union Research Institute for Electrification of Agriculture. Moscow. Director: A.V. Demin.

3. Central Research Designing and Technological Institute for Mechanization and Electrification of Animal Husbandry of the Southern Zone of the U.S.S.R. Zaporozhye. Director: P.I. Chervenko

G. Department of Forestry and Agricultural Forest Melioration
Academician-Secretary: A.D. Bukshtynov

1. All-Union Research Institute of Agricultural Forest Melioration. Volgograd. Director: V.N. Vinogradov

H. Council on Protection of Soil Against Erosion. Chairman of the Council: Academician: V.D. Pannikov

1. All-Union Research Institute of Protection of Soil Against Erosion. Kursk. N.K. Shikula

I. Southern Department of Vaskhnil
Acting Chairman: V.F. Peresypkia

1. V.Ya. Yuryev Ukrainian Research Institute of Plant Industry, Breeding, and Genetics. Kharkov. Director: I.M. Polyakov

2. Ukrainian Research Institute of Animal Physiology and Biochemistry. Lvov. Director: Z.P. Skorodinsky

3. Ukrainian Research Institute of Economics and Management of Agriculture. Kiev. Director: I.I. Lukinov

4. A.N. Sokolovsky Ukrainian Research Institute of Soil Science and Agrochemistry. Kharkov. N.K. Krupsky

5. Ukrainian Research Institute of Irrigation Farming. Kherson. Director: A.A. Sobko

6. Ukrainian Research Institute of Plant Protection. Kiev. Director: V.P. Vasilyev

7. Ukrainian Research Institute of Arable Farming. P/O Chabany, Kievo-Svyatoshinsky rayon, Kievskaya oblast. Director: V.N. Evminov

8. Ukrainian Research Institute for Mechanization and Electrification of Agriculture. Kiev. Director: F.P. Polupanov

9. Ukrainian Research Institute of Vegetable Growing and Melon Production. P/O Seleksionnaya, Kharkovsky rayon, Kharkorskaya oblast. Director: G.L. Bondarenko

10. Ukrainian Research Institute of Potato Growing. P/O Nemishaevo, Borodyansky rayon, Kievskaya oblast. Director: V.I. Overchuk

11. Ukrainian Research Institute of Horticulture. Kiev. Director: A. I. Shepelsky

12. Poltava Research Institute of Swing Breeding. Poltava. Director: F.K. Pochernyaev

13. Ukrainian Research Institute of Poultry Breeding. Yuzhnaya Zheleznaya doroga, st. Borki, Kharkovskaya oblast. Director: V.D. Lukyanova

14. V.Ye. Tairdv Ukrainian Research Institute of Grape Growing and Wine Making. Odessa. Director: P.I. Litvinov

15. Ukrainian Research Institute of Experimental Veterinary Science Kharkov. Director I.N. Gladenko

16. Ukrainian Central Research Institute of Agricultural Microbiology. Chernigov. Director V.S. Sivers

17. Research Institute of Animal Husbandry of Forest-Steppe and Woodlands of the Ukrainian SSR P/O Kulinichi, Kharkov. Director I.A. Davitenko.

18 Ukrainian Research Institute of Animal Husbandry of Steppe Regions ("Askania-Nova"), Pesyolok Askavia-Nova, Chaplinsky rayon, Kersorskoya oblast. Director F.I. Krutyporokl

19. Research Institute of Arable Farming and Animal Husbandry of Western Regions of the Ukrainian SSR. S. Obroshino, Pustomytovsky rayon, Lvovskaya oblast. Director: F.Yu. Palfy.

J. Siberian Department of Vaskhnil
Chairman: I.I. Sinyagin

1. Siberian Research Designing and Technological Institute of Animal Husbandry. Novosibirsk. Director: A.P. Kalashnikov

2. Siberian Research Institute for Mechanization and Electrification of Agriculture. Posyolok Baryshevo, Navosibirskaya oblast. Director: B.V. Parlov.

3. Siberian Research Institute of Agricultural Economics. Novosibirsk. Director: M.I. Tikhomirov

4. Siberian Research Institute of Chemization of Agriculture. Novosibirsk. Director: O.A. Ivanov

5. Siberian Research Institute of Fodder Crops Posyolok Ogurtsovo. Novosibirskaya oblast. Director: A.I. Shishkin

6. Siberian Research Institute of Agriculture. Omsk. Director: B.I. Gerasenkov

7. All-Russian Research Institute for Soybeans. P/O Sadovoe, Amurskaya oblast, Blagoveshchensk-na-Amure. Director: V.F. Kuzin

8. Scientific Research Institute of Agriculture of Extreme North. 5, Norilsk, Krasnoyarsky kray. Acting Director: D.V. Savelyev

APPENDIX 3.--BRANCH AND ZONE RESEARCH INSTITUTES WITH SUBSTANTIAL PROGRAMS ON PEST MANAGEMENT

1.	All-Union Research Institute for Sugar Beets	Kiev, 110, Klinicheskaya street, 25
2.	All-Union Research Institute for Tobacco and Rustic Tobacco	Krasnodar, P.O. 55
3.	All-Russian Research Institute for Sugar Beets and Sugar	Voronejskaya region, Berezovsky district, P.O. Ramonj
4.	All-Union Research Institute for Flax	Kalininskaya region, Torjok, Lunacharsky str. 35
5.	All-Union Research Institute for Plant Culture	Leningrad, Center 1, Gertsena 44
6.	All-Union Research Institute for Agricultural Microbiology	Leningrad, Gertsena 44-42
7.	All-Union Research Institute for Olive Crops	Krasnodar, P.O. 38, Philatov street 17
8.	All-Union Research Institute for Maize	Dnepropetrovsk, Dzerjinskiy street, 14
9.	All-Union Research Institute for Grain Farming	P.O. Shortandy, Tselinogradskaya region
10.	All-Union Research Institute for Selection and Seedage of Vegetables	Moskovskaya region, Odintsovsky district
11.	All-Russian Research Institute for Viticulture	Rostovskaya region, Novocherkassk, Arsenalnaya street, 15
12.	All-Union Research Institute for Helminthology	Moscow, M-259, B. Cheremushkinskaya, 90
13.	All-Union Research Institute for Ether-Olive Crops	Simferopol 17, Kievskaya street 75
14.	All-Union Research Institute for Humid Vegiculture and Melon-growing of the USSR Ministry of Agriculture	Astrakhanskaya region, Kamyzyak, Lubich street 10
15.	All-Union Research Institute for Microbiological Means of Plant Protection and Bacterial Preparations	Moscow, G-242, Konushkovsky Pereulok 31

16.	All-Union Research Institute for Agricultural and Special Usage of Civil Aviation	Krasnodar, Korov street, 130
17.	All-Union Research Institute for Chemical Means of Plant Protection	Moscow, Ugrejskaya 33
18.	All-Union Research Institute for Forage	Moscow region, Lugovaya station
19.	All-Union Research Institute for Leguminous Crops	Oreol, P.O. Experimental station
20.	State Nikitsy Garden of the All-Union Academy of Agricultural Sciences	Yalta, Crimea
21.	Ukrainian Urjev Research Institute of Plant Growing, Selection and Genetics	Kharkov, Moscovsky pereulok 142
22.	Ukrainian Research Institute for Potatoes	Kiev region, Borodinsky district, P.O. Nemeshaevo
23.	Belorussian Research Institute for Potato and Fruit Growing and Vegeculture	Minsk 64, Kazinets street 90
24.	All-Union Research Institute for Cotton Growing of the U.S.S.R. Ministry of Agriculture	Tashkentskaya region, Ordjonikidze district
25.	Altajsky Zone Research Institute of Agriculture	Barnaul 51, Altaj region
26.	Bashkirsky Zone Research Institute of Agriculture	Ufa, Zorge street, 19
27.	Far East Research Institute of Agriculture	Khabarovsk, 31, Karl Marx street, 107
28.	Dagestansky Zone Research Institute of Agriculture	Mahatschkala, P.O. 53
29.	Donskoy Zone Research Institute of Agriculture	Rostovskaya region, Aksajsky district, Rassvet village
30.	Krasnodar Research Institute of Agriculture	Krasnodar P.O. 12
31.	Krasnoyarsky Research Institute of Agriculture	Solyanka station of East-Siberian railway

32.	All-Russian Research Zone Insti- of Horticulture of Non-Black Earth Region	Moscow, V-403, Birulevo
33.	Research Institute of Potato Growing	Moscow region, s. Korenevo, P.O. Kraskovo, 2
34.	Research Institute of Vegeculture	Moscow region, Mytishi, 14
35.	Research Institute of Agriculture of Non-Black Earth Region	Moscow, Nemtchinovka
36.	Research Institute of Agriculture of Central Black Earth Region	Voronej region, P.O. Talovaya, Kamennaya Steppe
37.	North-East Research Institute of Agriculture	Magadan, Gorky street 7-6
38.	North Zauralsky Research Institute of Agriculture	Tumen, P.O. Moscovskoe
39.	North-West Research Institute of Agriculture	Leningrad region, Siverskaya station, Belogorka
40.	North-Caucasian Zone Research Institute of Horticulture and Viticulture	Krasnodar, P.O. 63, Shossejnaya street 2
41.	South-East Research Institute of Agriculture	Saratov, 2-ya Datchnaya street
42.	Stavropolsky Research Institute of Agriculture	Stavropolsky Kraj, Shpakovskoe village
43.	Ural Research Institute of Agriculture	Sverdlovsk B-61
44.	Tartar Research Institute of Agriculture	Kazan, 48
45.	Moldavian Research Institute of Horticulture, Viticulture and Wine Making	Kishinev, 19, Fruktovaya street 14
46.	Moldavian Research Institute of Humid Farming and Vegeculture	Tiraspol, Mir street 50

Prepared by Dr. A. I. Smetnik, September 27, 1973.

APPENDIX 4.--MICROBIAL AND VIRAL INSECTICIDAL PREPARATIONS IN COMMERCIAL USE OR UNDER DEVELOPMENT IN THE U.S.S.R.

Preparation	Target species, preparations registered for commercial use	Institutions with lead roles
Entobacterin -3 (Based on Bacillus thuringiensis- serotype-5; virtually free of exotoxin. Applied at 1% with 0.02% carbaryl against gypsy moth; mixed with phosalone and dimethoate to control tortricids. Can be mixed with dicofol and menazon for simultaneous mite and aphid control respectively; but cannot be mixed with Bordeaux mixture).	Effective against 85 species. Registered for many uses throughout the U.S.S.R. but principally used on orchards, cabbage, shade trees, and forests.	Developed by All-Union Scientific Research Institute for Plant Protection. Manufactured by Ministry of Microbial Industry plant near Moscow in multitonnage quantities. Production is hampered by bacteriophages. Safety tests were conducted by All-Union Scientific Research Institute of Hygiene and Toxicology, Kiev.
Dendrobacillin (Based on Bacillus thuringiensis serotype 4a & 4b; contains small amount of B-exotoxin; applied by spraying or in bait).	Registered for use against Dendrolimus sibiricus on forests, and Laphygina exigua, Agrotis segetum, and Chloridea obsoleta on cotton. Under advanced development for use in orchards and cabbage.	Developed by Irkutsk University. Manufactured in Siberia as well as near Moscow by Ministry of Microbial Industry.

Preparation	Target species, preparations registered for commercial use	Institutions with lead roles
Boverin (Beauverin) (Based on carefully selected highly virulent strains of *Beauveria bassiana*).	Registered for use in a mixture with low concentration of carbaryl for use against the Colorado potato beetle. Under advanced development for use against codling moth and Oriental Fruit Moth. May be impregnated in bands around tree trunks to serve as centers of infection. Also used in field trials in a mixture containing entobacterin and trichlorfon at reduced concentrations.	Developed by Ukrainian Scientific Research Institute for Plant Protection. Safety tests conducted by All-Union Research Institute of Hygiene and Toxicology, Kiev. Manufactured in Kiev: One ton in 1973; 10 tons projected for 1974. Production is somewhat hampered by two-step fermentation process, but improvements are being made. A plant is under construction at Kishinev to produce boverin on commercial scale.
Insectin (Based on *Bacillus insectus* which is similar to B. *thuringiensis* serotype - 1).	Under advanced development for use against *dendrolimus sibericus*.	Krasnoyarsk Forestry Institute.
Toxobacterin (Based on Bacillus insectus and contains high content of B-exotoxin).	Broad spectrum	All-Union Scientific Research Institute of Microbiological Methods of Plant Protection and Bacterial Preparations, Moscow and All-Union Scientific Research Institute for Plant Protection, Leningrad.

Entobacterin - 5 (Based on <u>B.t.</u> var. galleriae and contains spores, crystals, and free exotoxin).	Broad spectrum	All-Union Scientific Research Institute of Plant Protection, Leningrad.
Bitoxibacillin (Based on <u>B.t.</u> var. <u>thuringiensis</u>, strain 202).	Very broad spectrum	All-Union Scientific Research Institute of Agricultural Microbiology, Leningrad.
Exotoxin 17-2 (Based on B. <u>thuringiensis</u>).	Cabbage maggot; applied as a soil drench mixed with organophosphate insecticides.	All-Union Scientific Research Institute for Agricultural Microbiology, Leningrad.
B.I.P. - 837 (Based on <u>Bacillus thuringiensis</u>).	Somewhat similar host range as entobacterin.	All-Union Scientific Research Institute for Microbial Methods and Bacterial Preparations.
BTS (Based on <u>Bacillus thuringiensis</u>).	Somewhat similar host range as entobacterin.	All-Union Scientific Research Institute for Microbial Methods and Bacterial Preparations.
Mycotoxins I-V	Broad spectrum. To be used as adjuvants for entobacterin and nuclear polyhedrosis viruses.	Institute of Microbiology and Virology, Kiev.
<u>Cordyceps clavulata</u> Ascospores are sprayed onto nut trees in May.	Acacia soft scale (<u>Eulecanium corni</u>).	Azerbaidzhan Scientific Research Institute of Plant Protection (method of culturing has been developed).

Preparation	Target species, preparations registered for commercial use	Institutions with lead roles
Plistophora schubergi (Cultured on Agrotis ypsilon, but this microsporidan infects numerous noctuids throughout U.S.S.R.).	Barathra brassicae Serves to activate latent NPV.	All-Union Scientific Research Institute of Plant Protection.
Aschersonia aleurodis (Strain obtained from U.S.).	Dialeurodes citri Effective in commercial scale tests. Facility for industrial production is lacking.	Georgian Research Institute for Plant Protection.
Entomophthora thaxteriana Spores are formulated with milk powder.	Aphis frangulae tetranychus cinnubarinus and Tetranychus urticae; very effective in greenhouses.	Institute of Biology, Academy of Sciences Latvian SSR.
Metarrhizium anisoplae Conidia are sprayed.	Broad spectrum on soil stages of insects including the Colorado potato beetle.	Ukrainian Scientific Research Institute for Plant Protection and Krasnoyarsk University.
Coniotirium (Based on fungus coniotirium).	San Jose Scale. Effective in large-scale trials. Production plant is lacking.	Quarantine Laboratory Pjatigorsk, RSFSR.
Nosema carpocapsa	Codling moth	All-Union Scientific Research Institute for Biological Methods of Plant Protection.
NPV	Lackey moth, Malacosoma neustria L. Effective in field tests.	Latvian Agricultural Academy.

Virin-EX (NPV).	Barathra brassicae. More effective than chlorophos.	Produced for large-scale trials by All-Union Scientific Research Institute for Microbial Methods of Plant Protection and Bacterial Preparations.
Virin-Ensh (NPV).	Porthetria dispar	Produced for large-scale trials by All-Union Scientific Research Institute for Microbial Methods of Plant Protection and Bacterial
Mixture of GV and NPV	Hypantria cunea promising in tests on 3,000 hectares in Transcarpathian Region of Ukr. SSR and in Moldavian SSR.	Ukrainian Scientific Research Institute of Plant Protection, Central Quarantine Laboratory, and All-Union Scientific Research Institute for Biological Methods of Plant Protection.
GV Formulated as a liquid or wettable powder	Agrotis segetum on cotton. Provides excellent protection.	Division of Microbiology, Academy of Sciences of Uxbek SSR. Taskent.
NPV	Chloridea obsoleta on cotton, tomatoes, and maize.	All-Union Scientific Research Institute of Plant Protection.
NPV (?)	Apomea (=Hadena) sordens on wheat in Kazakhstan. Research phases are nearing completion.	All-Union Scientific Research Institute of Plant Protection.

Preparation	Target species, preparations registered for commercial use	Institutions with lead roles
Numerous virus strains	Browntail moths, gypsy moth, grain and cabbage moths, selenoid and Siberian silkmoths, etc.	Siberian Research Institute of Chemization of Agriculture.
NPV	Apple-tree ermine moth and fruit-tree ermine moth.	Institute of Biology, Academy of Sciences of Latvian SSR.
Bactorodencide (Based on rodent typhus, _Salmonella enteriditis_ var. T. Sach and var. Prochor. Two formulations have been developed: granular and bonemeal powder. The granular formulation is broadcast in the rodent habitats. The bonemeal powder formulation is mixed with selective baits.)	Mice and other rodents. Absolutely safe to man and useful fauna.	All-Union Scientific Research Institute of Agriculture Microbiology.
Trichodermin (Based on _Trichoderma_ strains. Applied as a seed dressing and by incorporation into soil.)	Control of alternariosis, phomosis, gray and bacterial rots on cabbage, cucumbers, and carrots. Also control of storage rot (_Sclerotina_) of cucumbers.	Belorussian Scientific Research Institute of Plant Protection.
Phytobacteromycin	Control of bacterioses of beans, soybeans, mulberry, fusarium wilt of legumes, root rots of wheat, phytophthora of potatoes and tomatoes, etc.	Ministry of Microbial Industry (In commercial use).

Polyoxin	Control of bacterioses of beans, soybeans, and mulberry, fusarium wilt of legumes, root rots of wheat, phytophthora of potatoes and tomatoes, etc.	Ministry of Microbial Industry (In commercial use).
Trichotecin More effective than fungicides and harmless to predatory mites.	Powdery mildew on many plants, root rot of wheat, moniliosis of wheat, anthracnosis of vegetables, black rot of sugarbeets.	Ministry of Microbial Industry (Used commercially, especially in greenhouses).
Arenarin	Bacterial canker and soft and blossom end rots of tomatoes.	All-Union Scientific Research Institute of Bacterial Preparations (Not in commercial production).
Imanin (Based on <u>Hypericum</u>).	Control of virus diseases of tomatoes and tobacco.	All-Union Scientific Research Institute of Bacterial Preparations (Not in commercial production).

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